Life Cycle Assessment Of Organic Diversion Alternatives And Economic Analysis For Greenhouse Gas Reduction Options

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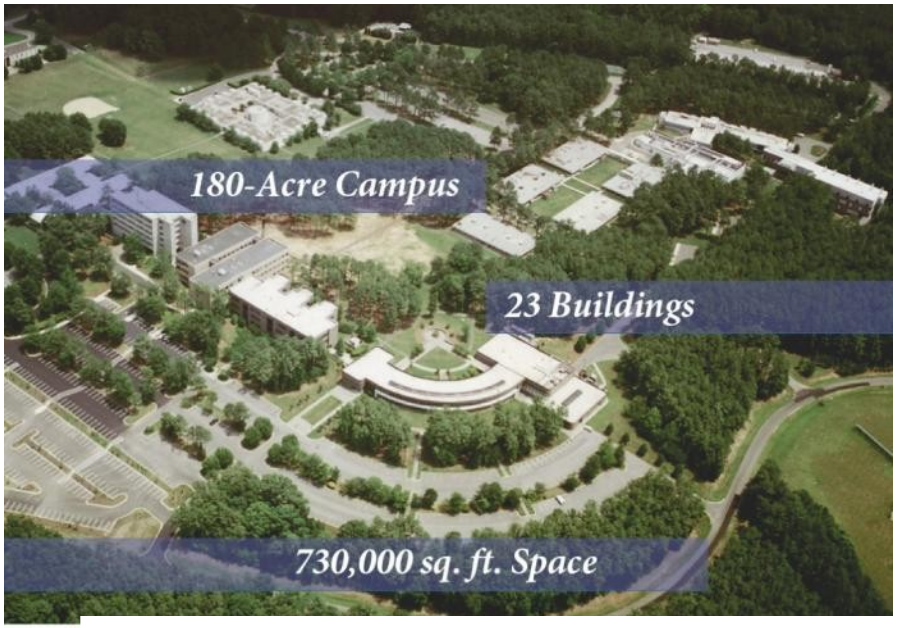
Presentation Outline

- Project organization and information:
  - Project team
  - Goal and products
  - Scope and boundary elements common to both the LCA and economic analysis
  - Tasks and schedule
- LCA approach
- Life cycle burdens and benefits by technology
- Key issues
- Next steps

RTI International

RTI is an independent, non-profit research organization formed in 1958 and dedicated to improving the human condition. RTI's main areas of research include:

- Health Sciences
- Environmental Sciences
- Education and Training
- Social and Economic Development
- Advanced Technology



Project Team

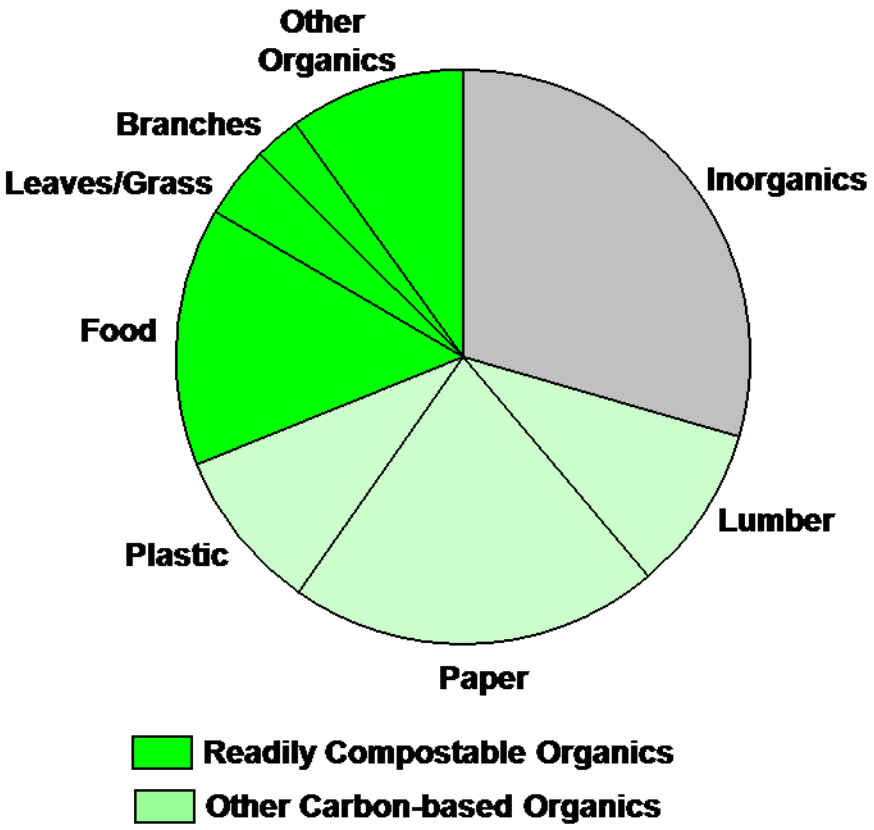
- RTI International (Prime)
  - LCA expertise
  - Solid waste modeling expertise
  - GHG/climate change expertise
- R.W. Beck
  - Economics expertise
  - Solid waste modeling expertise
  - GHG/climate change expertise
- Sally Brown
  - Organics expertise
  - GHG/climate change expertise
- Matthew Cotton
  - Organics expertise

Project Goals, Tasks, and Outputs

- Project goals is to develop data and tools to analyze the cost and life cycle GHG aspects for organic waste diversion technologies
- Main Tasks:
  - LCA
  - Economic analysis
  - GHG tool development
- Key Products:
  - LCA and economic analysis of organic waste diversion technologies (2006 base year and out to 2020)
  - GHG tool

Waste Stream Characterization

- 40 million tons of organics are disposed statewide.
- Organics breakdown:
  - 70% carbon-based organics
  - 30% is readily compostable
  - 21% is paper
  - 15% is food
- Regional characterization of organics being developed.



Technologies Under Consideration

- Landfill (baseline)
- Recycling
- Composting
- Chipping/Grinding
- Anaerobic Digestion
- Biomass to Energy
- Waste to Energy
- Acid Hydrolysis
- Gasification

Geographic Scope

- State-wide and regional analyses:
  - Greater Los Angeles: includes the counties of Los Angeles and Orange.
    Note: Riverside and San Bernardino Counties added after Jan. '08 workshop.
  - Southern Bay Area: includes the counties of Alameda, San Francisco, San Mateo, and Santa Clara.
    Note: Contra Costa County added after Jan. '08 workshop.
  - Southern Central Valley: includes the counties of Fresno, Kern, Kings, Madera, and Tulare.

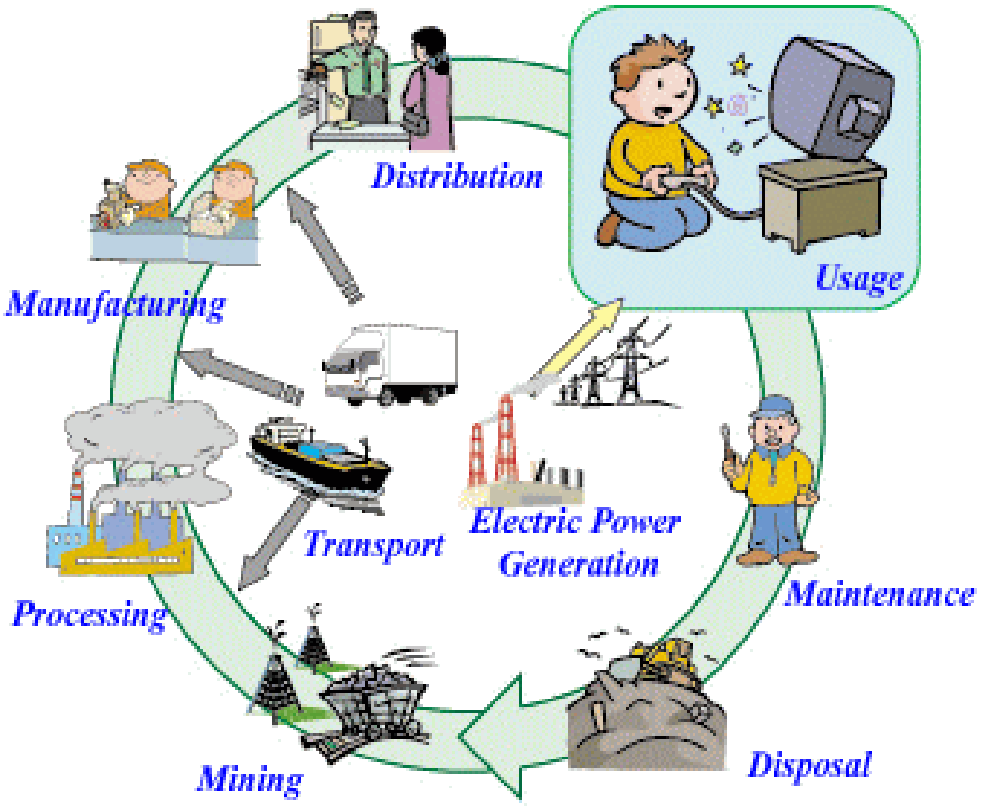
Main Tasks and Schedule

LIFE-CYCLE ASSESSMENT	
Task 4—Life-Cycle Assessment Screening Phase	Fall 2007
Task 5—Life-Cycle Assessment Model	Winter 2007/2008
Task 6—Life-Cycle Assessment and Data Collection	Winter 2007/2008
Task 7—Life Cycle Impact Assessment	Spring 2008
Task 8—Interpretation of Life Cycle Impact Assessment	Spring 2008
ECONOMIC ANALYSIS	
Task 9—Capital and Operating Costs	Summer 2008
Task 10—Cost Savings	Summer 2008
Task 11—Cost Effectiveness Assessment	Fall 2008
Task 12—Economic Impacts	Summer 2008
GHG TOOL AND FINAL REPORT	
Task 13—Customized California GHG Tool	Winter 2008/2009
Task 14—Draft Final Report	Fall 2008
Task 15—Final Report	Winter 2008/2009

Life Cycle Assessment Approach and Issues

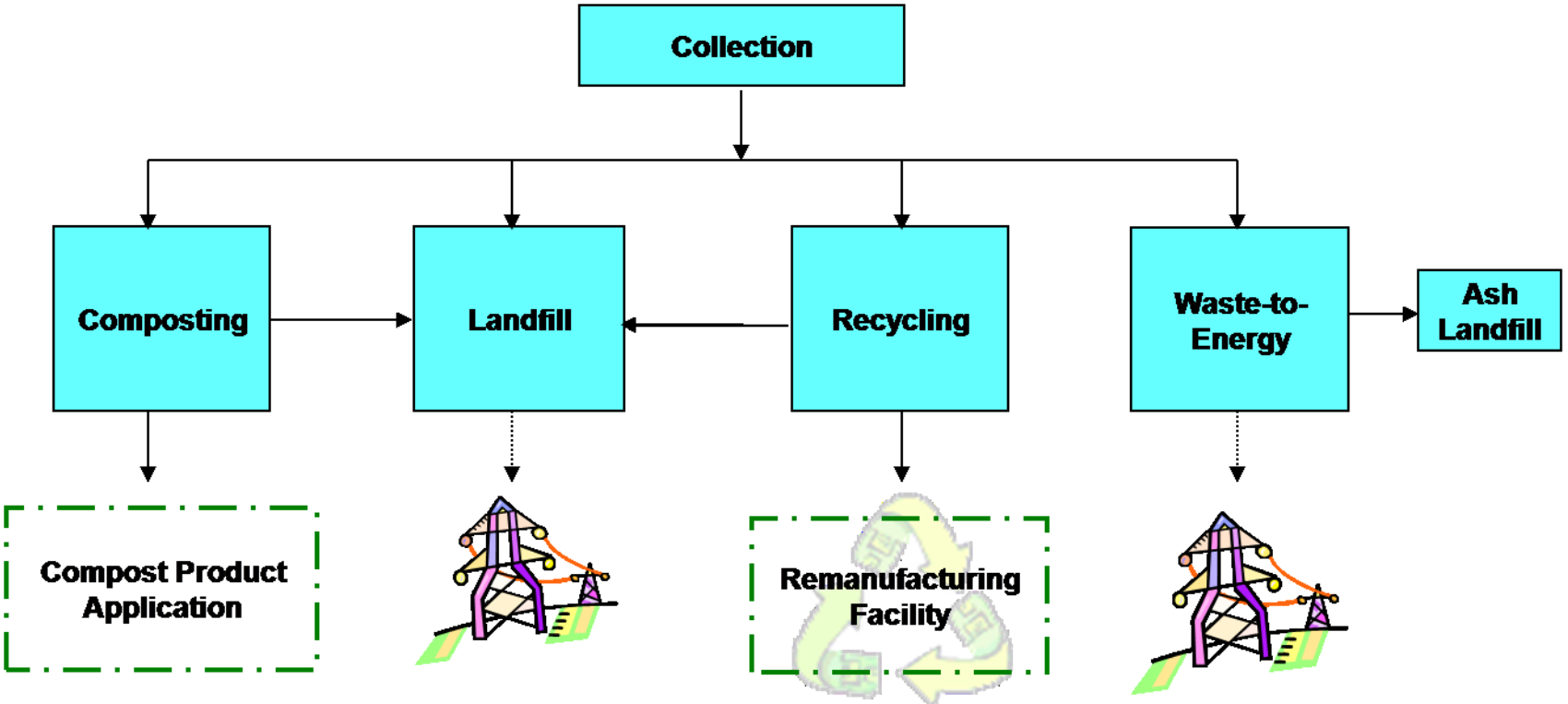
What is Life Cycle Assessment?

- A systems analysis, not isolated operations.
- Considers upstream and downstream burdens.
- Multi-media and multi-pollutant.
- Main components:
  - Inventory Analysis
  - Impact Assessment
  - Interpretation

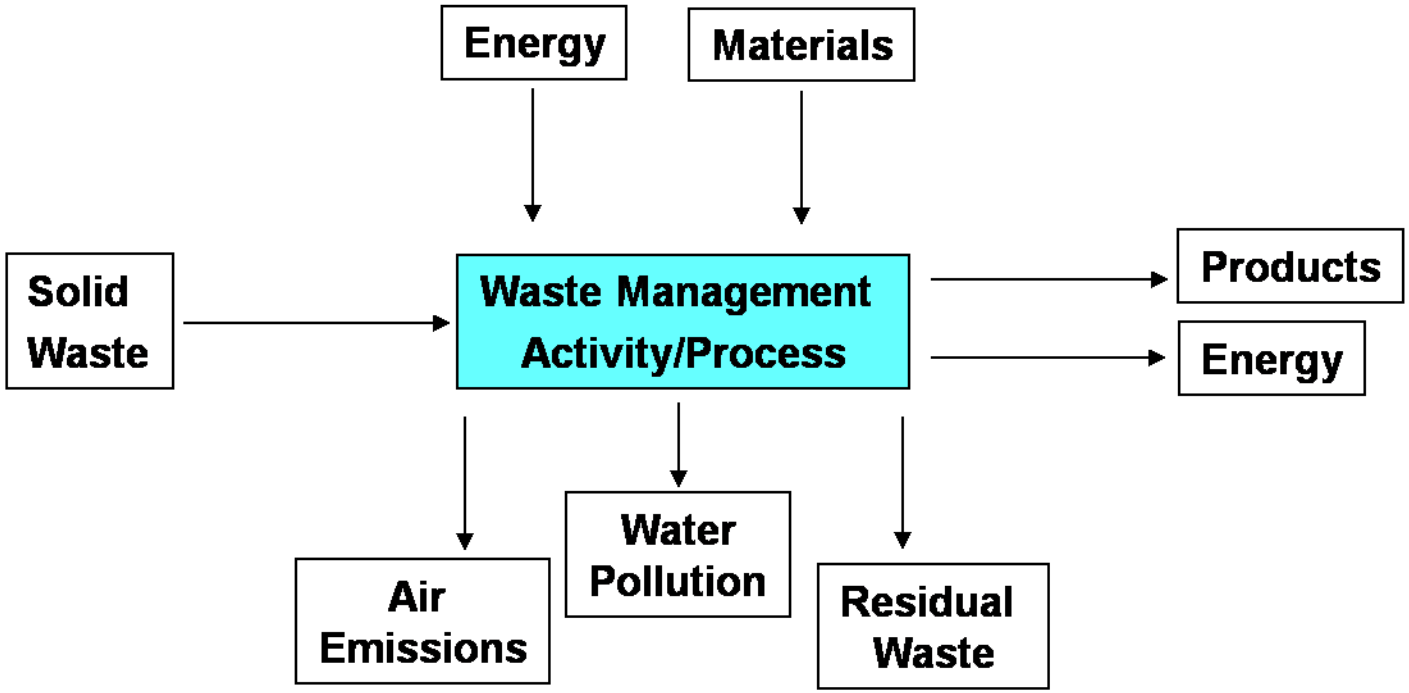


Typical Product-Type LCA

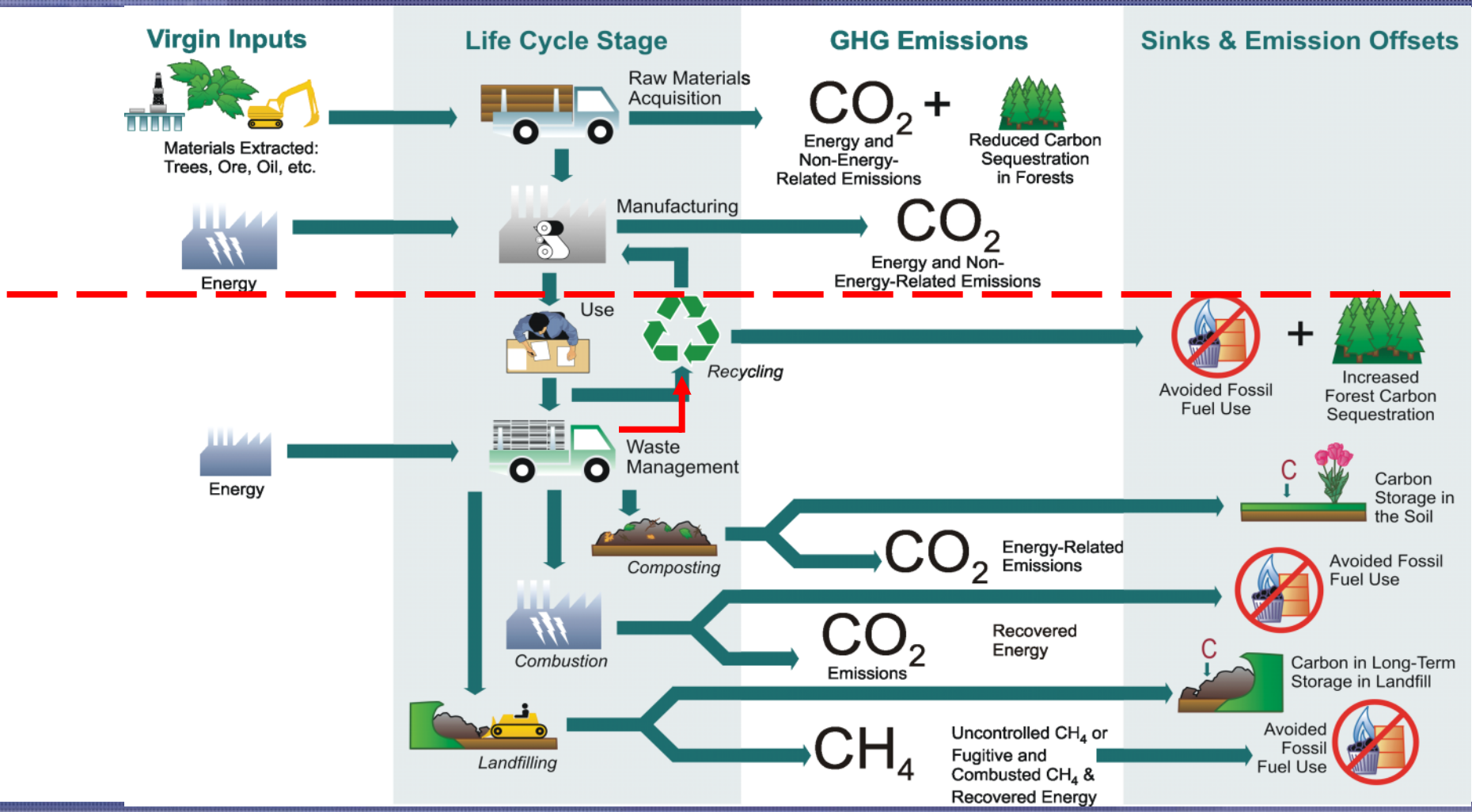
Life Cycle Concept Applied to Waste Management Systems



Waste Management Process Boundaries

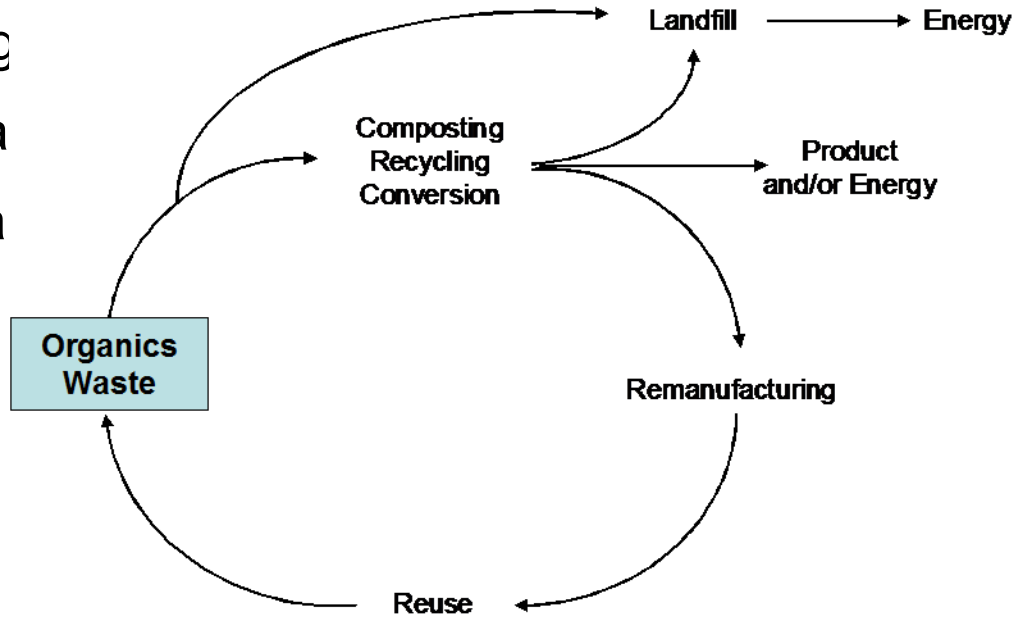


Greenhouse Gas Emissions and Solid Waste Management



LCA Approach For This Project

1. Screen existing tools
2. Define scope and boundaries
3. Identify data needs and g
4. Collect state and regiona
5. Design and model scena
6. Analyze LCA impacts
7. Use results in GHG tool

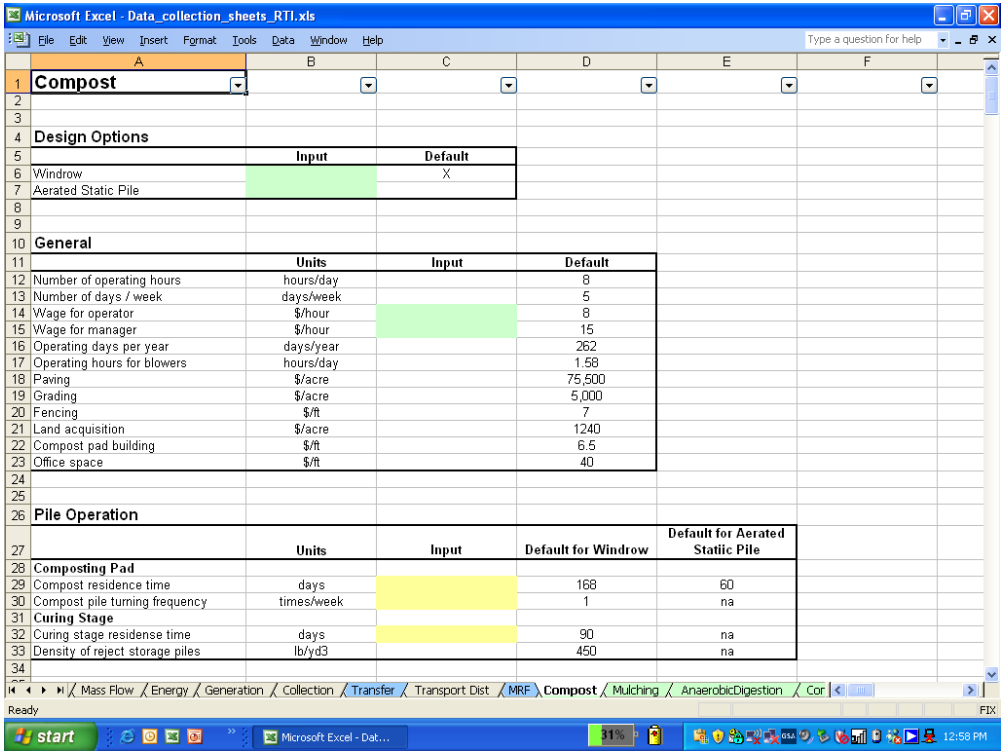


Screening of Existing Tools

- CACP (Clean Air and Climate Protection)
- CENTURY
- EASEWASTE (Environmental Assessment of Solid Waste Systems and Technologies)
- IWM (Integrated Solid Waste Management tool)
- IWM-2
- LCA-IWM (Life Cycle Assessment-Integrated Waste Management)
- MSW DST (Municipal Solid Waste Decision Support Tool)
- ORWARE (Organic Waste Research)
- WISARD (Waste-Integrated Systems for Assessment of Recovery and Disposal)
- WARM (Waste Reduction Model)
- WASTED (Waste Analysis Software Tool for Environmental Decisions)
- WRATE (Waste and Resources Assessment Tool for the Environment)
- AWAST (Tool to Aid the Management and European Comparison of Municipal Solid Waste Treatment Methods for a Global and Sustainable Approach)
- EUGENE
- MIMES/WASTE or MWS (Municipal Waste Management Systems tool)
- SWIM (Solid Waste Integrated Management Model)

LCA Data Collection: What Type of Data Do We Need?

- Basic facility design and operation
- Waste flow
- Energy and materials consumption
- Efficiency factors
- Emission factors
- Products (energy/materials)
  - Offsets of other products
- Transportation distances



Microsoft Excel - Data_collection_sheets_RTI.xls

File Edit View Insert Format Tools Data Window Help

Compost

Design Options

	Input	Default
Windrow		X
Aerated Static Pile		

General

	Units	Input	Default
Number of operating hours	hours/day		8
Number of days / week	days/week		5
Wage for operator	$/hour		8
Wage for manager	$/hour		15
Operating days per year	days/year		262
Operating hours for blowers	hours/day		1.58
Paving	$/acre		75,500
Grading	$/acre		5,000
Fencing	$/ft		7
Land acquisition	$/acre		1240
Compost pad building	$/ft		6.5
Office space	$/ft		40

Pile Operation

	Units	Input	Default for Windrow	Default for Aerated Static Pile
Composting Pad				
Compost residence time	days		168	60
Compost pile turning frequency	times/week		1	na
Curing Stage				
Curing stage residense time	days		90	na
Density of reject storage piles	lb/yd3		450	na

Mass Flow | Energy | Generation | Collection | Transfer | Transport Dist | MRF | Compost | Mulching | AnaerobicDigestion | Cor

Ready

Landfill

- Conventional, bioreactor, and ash landfill design types
- Designed and operated according to Federal standards
- Different gas management options:
  - Venting
  - Collection and flaring
  - Collection and utilization for energy recovery

Landfill Burdens and Benefits

Life Cycle Burdens

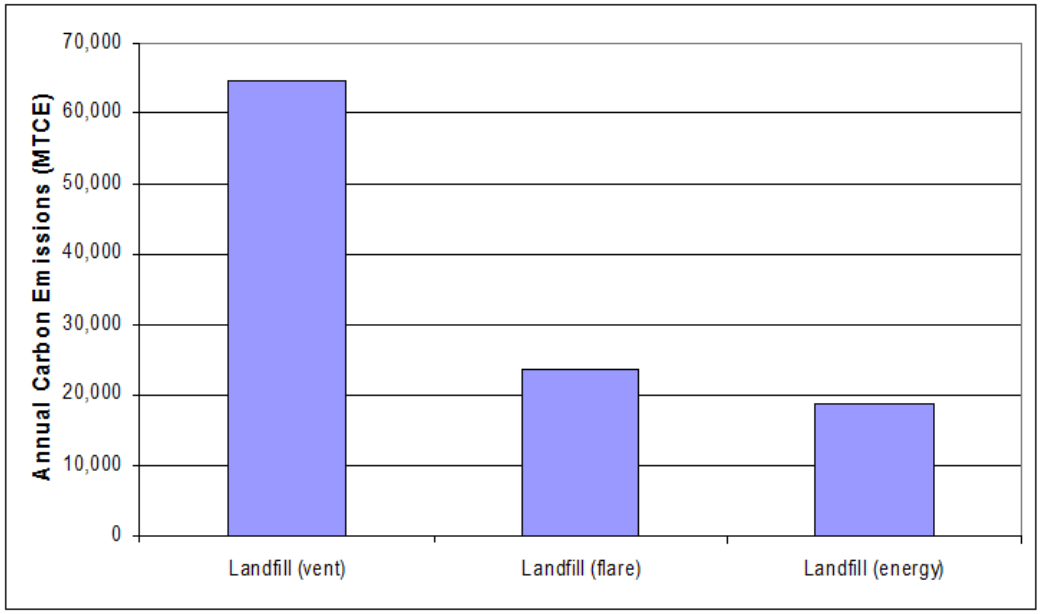
- Energy and emissions associated with material inputs (e.g., liner)
- Energy and emissions associated with landfill operation
- Landfill gas emissions
- Energy and emissions associated with leachate collection and treatment

Life Cycle Benefits

- Collection and utilization of gas for energy recovery and offset of utility sector emissions
- Potential long-term storage of carbon

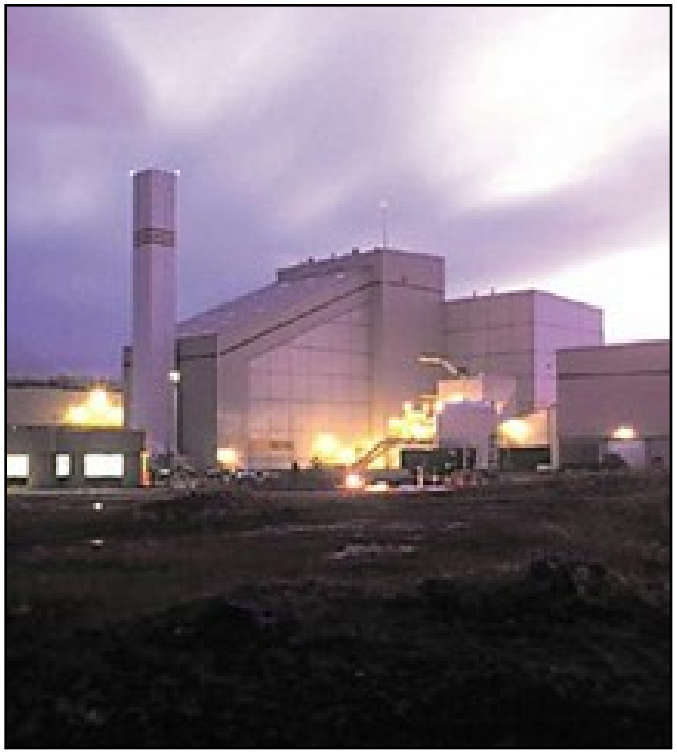
Landfill Gas Collection Efficiency

- Landfill gas contains about 50% methane which is a potent GHG.
- Gas collection and control can greatly reduce methane emissions.
- The assumed gas collection efficiency significantly impacts GHG emissions.



"Waste-to-Energy" Systems

- Thermal Systems:
  - Conventional mass burn
  - Gasification
  - Pyrolysis
  - Others (e.g., plasma arc)
- Non-Thermal Systems:
  - Anaerobic digestion
  - Hydrolysis



Waste-to-Energy Burdens and Benefits

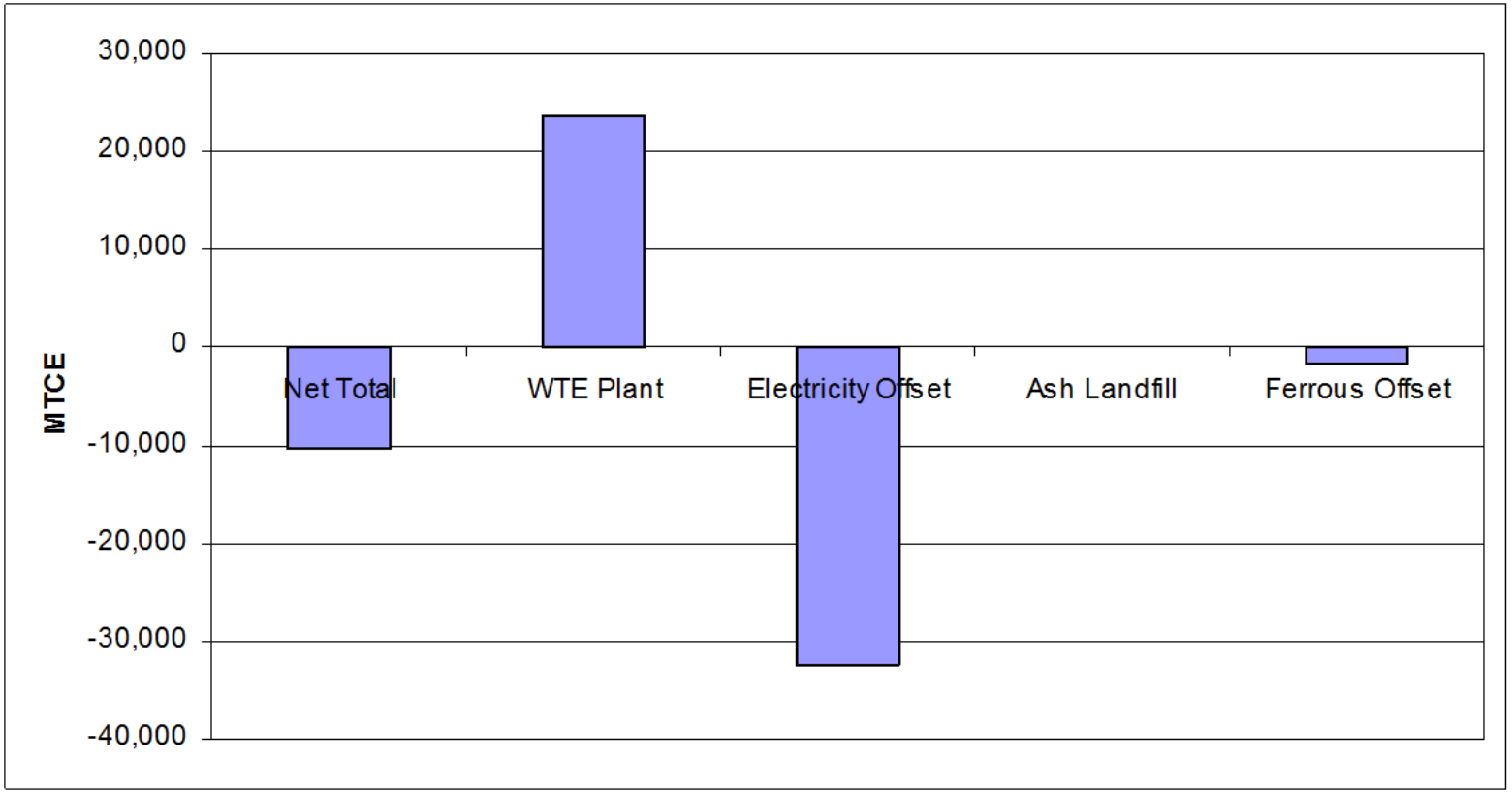
Life Cycle Burdens

- Energy and emissions associated with facility operation
- Energy and emissions associated with transport of recovered metals to remanufacturing plants
- Energy and emissions associated with transport of ash and/or residuals to landfill
- Energy and emissions associated with ash/residuals disposal

Life Cycle Benefits

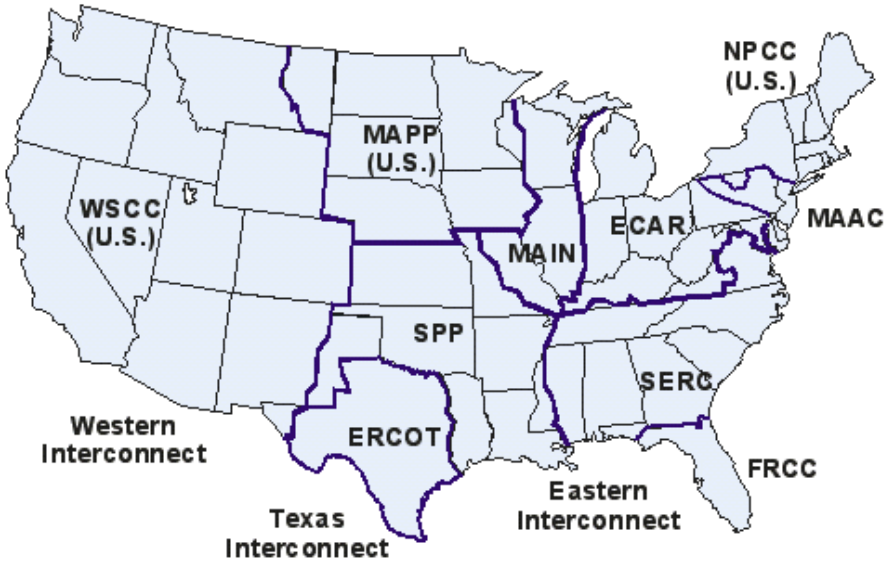
- Diversion of MSW from landfills
- Energy production and offset of utility/petroleum sector emissions
- Materials recovery and recycling

Example WTE GHG Emissions Profile



WTE Electricity Production and Assumed Utility Offset

- Energy offsets create significant LCA benefits
- The mix of fuels used to produce electricity varies throughout the U.S.
- The mix of fuels displaced can significantly impact emissions:
  - Fossil
  - Non-fossil



Recycling

- Designed to accepted different types of material:
  - Mixed MSW
  - Commingled recyclables
  - Presorted recyclables
- Automated or manual
- Market for recycled materials are regional

Recycling Burdens and Benefits

Life Cycle Burdens

- Energy and emissions associated with separate collection
- Energy and emissions associated with MRF operation
- Energy and emissions associated with transportation of materials to remanufacturing

Life Cycle Benefits

- Diversion of MSW from landfills
- Conservation of energy and virgin resources
- Potential forest carbon sequestration associated with paper recycling

Composting

- Designed to accept different types of material:
  - Organics only
  - MSW
- Highly automated in-vessel to less automated windrow and aerated static pile designs.
- End uses for compost product are regional and dependant on quality.

Composting Burdens and Benefits

Life Cycle Burdens

- Energy and emissions associated with separate collection
- Energy and emissions associated with compost operation
- Energy and emissions associated with transportation of compost product and residuals

Life Cycle Benefits

- Diversion of organics/MSW from landfills
- Potential beneficial offsets of other products (fertilizer, etc.)
- Potential soil carbon sequestration associated with application of compost product

Key LCA Technical Issues

- Treatment of ADC
- Accounting and reporting carbon storage/sequestration:
  - Landfill
  - Forest (paper recycling)
  - Soil (compost application)
- Lack of data for compost related beneficial offsets:
  - What is offset?
  - How much is offset?
  - Data to characterize the offset?
- Lack of real-life operating and emissions data for newer technologies (e.g., conversion)

Next Steps (0-3 months)

- Finalize scope and boundaries:
  - Technologies to include in analyses
  - Approaches for handling technical issues
- Initiate data collection:
  - Characterize beneficial offsets for composting
  - LCA/Economic-specific data for technologies
- Design technology scenarios and conduct preliminary analyses
- Develop conceptual framework for GHG tool